AD-A045 601 BOEING AEROSPACE CO SEATTLE WA LOGISTICS SUPPORT AND--ETC F/G 14/2
USER'S GUIDE FOR TEST AND EVALUATION SECTIONS OF MIL-H-46855.(U)
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FINAL REPORT
User's Guide for Test and Evaluation Sections of MIL-H-46855

Boeing Aerospace Company
Logistics Support and Services
Seattle, Washington 98124

June 30, 1977

Prepared for
Naval Air Development Center
Warminster, Pennsylvania 18974

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: N62269-76-C-0434
2. GOVT ACCESSION NO.: (9)
3. RECIPIENT'S CATALOG NUMBER: Final

4. TITLE (and Subtitle): (6) FINAL REPORT User's Guide for Test and Evaluation Sections of MIL-H-46855
5. TYPE OF REPORT & PERIOD COVERED: Technical Report Jul 1976 through Jun 1977
6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): (10) Charles W. Geer
8. CONTRACT OR GRANT NUMBER(s): (15) N62269-76-C-0434

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Boeing Aerospace Company, Logistics Support and Services, Seattle, Washington 98124
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: WR 24004, TJ 601

11. CONTROLLING OFFICE NAME AND ADDRESS: (11) 30 Naval Air Systems Command, Washington, D.C. 20060
12. REPORT DATE: June 1977
13. NUMBER OF PAGES: 12

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): Naval Air Development Center, Warminster, Pennsylvania 18974
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report): (12) 14p.

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Human Factors Engineering
Test and Evaluation
Data Item Descriptions

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The test and evaluation portions of MIL-H-46855 are elaborated upon in two guides, one for Navy managers and one for human factors engineering (HFE) user/evaluators. Several test and evaluation techniques are presented along with their capabilities and limitations. Recommendations are made for three modified HFE test and evaluation DID's and a preliminary draft of Navy T&E policy and procedure instructional documentation is also included.

(AD's A043 097 and A045 098)

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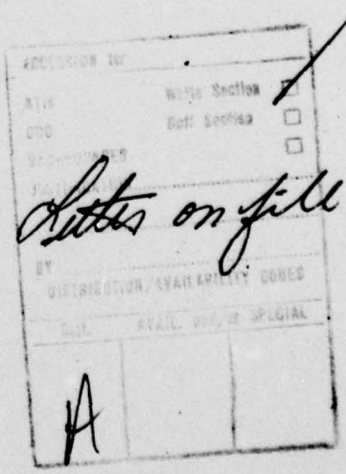
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

This report consists of three sections. The three sections are as follows:

a. Both the "User's Guide for the Test and Evaluation Sections of MIL-H-46855" and "Navy Manager's Guide for the Test and Evaluation Sections of MIL-H-46855" are prepared as separate documents, 0194-10006-1 and -2.

b. Drafts of three modified human factors engineering (HFE) Data Item Descriptions are contained on the following pages.

c. A draft of instructional documentation of Navy HFE test and evaluation (T&E) policy and procedures is contained on the following pages.



Blocks 1, 2, 4, 5, 6, 8 & 9 - no change.

3. DESCRIPTION/PURPOSE

This plan describes in detail the contractors proposed test and demonstration plan which will verify/evaluate the man-equipment interface requirements for the operation and maintenance of the system, as specified by the contract.

7. APPLICATION/INTERRELATIONSHIP

7.1 This data item describes the contractor's proposed plan for complying with requirements of MIL-H-46855, para. ~~3/2/2/4~~ 3.2.4.

7.2 The human engineering test plan delineates a detailed test program to be followed by the contractor and it is used by the procuring activity to assure completeness of contractor's test program and conformance to contractual requirements. Upon approval by the procuring activity, the Human Engineering Test Plan will supersede test and evaluation portions of the Human Engineering Program Plan (DI-H-2104) when specified in the Contract Data Requirements List.

7.3 The Human Engineering Test Plan shall be compatible with the program Test and Evaluation Master Plan (TEMP).

7.4 This data item is related to DI-H-2111, Human Engineering Test Report and DI-H-2112, Human Engineering Final Report.

10. PREPARATION INSTRUCTIONS

10.1 Unless otherwise indicated herein, the documents cited in this block, of the issue in effect on date of invitation for bids or request for proposals, form a part of this DID to the extent specified herein.

10.2 Human Engineering Test Plan shall be prepared in compliance with MIL-H-46855, para. 3.2.4 in contractor format for systematic and comprehensive testing necessary to verify that the system can be safely operated; maintained and supported by user personnel in accordance with contract requirements. The Human Engineering Test Plan shall describe the approach(es) for obtaining data and shall establish and explain all standards, tests, associated analyses, and other means that will constitute adequate proof upon completion of the development phase that acceptable levels of human performance, time, accuracy and safety factors can be achieved in operational use under specified manning levels.

10.3 The Human Engineering Test Plan shall consist of the following sections:

a. General. The detailed objectives, concepts and requirements for the Human Engineering Test Plan shall be in accordance with MIL-H-46855, para. 3.2.2.4 and shall be described with consideration being given to:

(1) Updating of human engineering data, task performance requirements, and operating and maintenance task procedures/technical data.

(2) Evaluation of personnel planning information (e.g., skills and quantities).

(3) Verification that all human engineering requirements, as specified by the contract, have been implemented.

PREPARATION INSTRUCTIONS (continued)

(4) Identification of potential training problems and validation of the functional adequacy of the training equipment, where applicable.

b. List of all systems subsystems, or equipment to be tested whose operation and/or maintenance requires critical human performance as defined by MIL-H-46855, para. 6.2.1.

c. Description of specific human engineering tests to be performed. This description shall also include a list of other tests of interest to human engineering (e.g., maintainability demonstrations, ILS reviews). Tests to be included in the testing program shall be briefly described. The types of tests to be described include:

(1) Drawing and equipment inspections.
(2) Human performance experimental tests.
(3) Man-machine simulation tests.
(4) Operator and maintainer mockup evaluations/demonstrations.
(5) Human engineering of technical manuals.
(6) Selected system tests (e.g., operational field tests, lighting level tests, noise and speech intelligibility tests, environmental control system tests).
(7) Training equipment, simulator and job aid tests/evaluations.
(8) Operator and maintainer safety.

d. Complete schedule of testing. If firm dates are not known, this shall be stated or estimates given. The schedule shall be prepared in milestone chart form or other form as approved by the procuring activity. The schedule shall include:

(1) Date of contract award.
(2) Implementation and reporting dates for each human engineering test conducted or monitored including CDRL item identification.
(3) Equipment delivery dates (feasibility, prototype, preproduction, or first article delivery).
(4) Technical manual delivery dates/validation dates.
(5) Maintainability demonstration dates.
(6) ILS review dates.
(7) Date of each system test conducted or monitored.
(8) Date of each special laboratory or simulation facility delivery.
(9) Date of each trainer, training simulator, or special job aid delivery.
(10) Test location(s).

e. Test procedures. Description of proposed human engineering test procedures, methodology and data analysis shall include.

(1) Test purpose.
(2) Detailed objectives.
(3) Methodological approach experimental or test design, including rationale.
(4) Apparatus, instrumentation, environment, facilities required.
(5) Data acquisition techniques, methods, conditions under which data are taken, data recording techniques, and parameters mearued.

PREPARATION INSTRUCTIONS (continued)

(6) Rationale for technique selection.
(7) Test criteria (e.g., design performance).
(8) Test subject selection, number, type, training, selection criteria.
(9) Test conductor, support engineer and technician task responsibilities.
(10) Description of data analysis/evaluation techniques.
(11) Description of test reporting, anticipated results, failures, data usage.

f. Identification of tasks for testing/evaluation. The Human Engineering Test Plan shall express the requirements for testing the performance of tasks or functions. Determining and testing critical tasks shall be given first priority for obtaining task performance data for analysis and evaluation. Particular attention shall be given to the consequences of critical task failure in terms of:
(1) Loss or degradation of system reliability or effectiveness.
(2) Decreased confidence in quality of system performance.
(3) Prediction of human-initiated equipment malfunctions during the operational phase.

g. Data Usage. Data usage concepts, objectives, requirements and plans shall be described with consideration being given to:
(1) Evaluation of human performance reliability. A description of a systematic method to be used for identifying and recording human-initiated malfunctions shall be provided. *(Showing how the data to be obtained may be (a) correlated with equipment performance data to determine a reliability index which can be related to system functions for use in predicting system performance)*
(2) Human performance quantification and evaluation. Plans shall be described to determine (a) the extent to which each critical task contributes to system performance and (b) the minimal level of human performance required to meet system operating requirements.
(3) Probability statement. The plan shall show how human performance within the system will be characterized by a probability statement where by human initialed system error and acceptable system error are compared by statistical techniques)
(3) Failure analysis. Plans for incorporation of human performance evaluation in failure analysis (MIL-H-46855, para. 3.2.4.3) efforts shall describe the basis for: (a) the limits of satisfactory human performance; (b) how these limits will be used to influence system updating and modification; (c) how design deficiencies will be analyzed (MIL-H-46855, para. 3.2.4.3) in terms of their effects on human performance.
(4) Information storage system. Plans shall be described for collecting and storing the pertinent HFE T&E data in an information storage and retrieval system.
(5) Maintenance engineering analysis. The plan shall describe utilization of logistic support analysis data)

PREPARATION INSTUCTIONS (continued)

h. Test reporting. The test plan shall describe contractor test reporting procedures and techniques (DI-H-2111, Human Engineering Test Report).

i. Final test report. The final test report shall summarize results of the individual tests. When a Human Engineering Final Report is required (DI-H-2112, Human Engineering Final Report), the final test report will be included in the verification, test and evaluation section.

j. Human Engineering program personnel qualifications. Resumes of key personnel responsible for and participating in, conduct of human engineering test planning, design, conduct, and reporting shall be provided upon request by procuring activity. ~~Including/complete~~ Resumes shall include descriptions of their individual qualifications and responsibilities.

k. Organizational responsibility. Description of the contractor's organizational structure relative to human engineering testing program responsibility shall be provided. This shall include a block diagram illustrating lines of authority, communication, and liaison.

l. Coordination. The test plan shall be compatible with the overall contractor test program and the program Test and Evaluation Master Plan (TEMP). The plan shall describe how the human engineering test program shall be coordinated with reliability, maintainability, training, and integrated logistic support efforts noting, where applicable, any segment of the human engineering program which will be conducted as a portion of these related programs.

REPORT, HUMAN ENGINEERING TEST DI-H-2111

Blocks 1, 2, 3, 4, 5, 6, & 8 - no change

7. APPLICATION/INTERRELATIONSHIP
7.1 This data item describes data documenting a portion of the contractor's effort required by MIL-H-46855, para. ~~3.2.2.4~~ 3.2.4.

7.2 The Human Engineering Test Report describes in detail the results of the contractor's demonstration of the item(s) under test, and it is used by the procuring activity to assure that the man-equipment interface requirements for the operation and maintenance of the system conform to the contractual requirements.

7.3 This data item is related to DI-H-2105, Human Engineering Test Plan.

9. REFERENCES (Mandatory as cited in block 10)
MIL-H-46855 ~~MIL-STD-831~~
10. PREPARATION INSTRUCTIONS
10.1 Unless otherwise indicated herein, the documents cited in this block, of the issue in effect on date of invitation for bids or request for proposals, form a part of this DID to the extent specified herein.

10.2 The Human Engineering Test Report shall be prepared in compliance with the provisions of MIL-H-46855, para. 3.2.4 ~~and 3.2.2.4 and where applicable MIL-STD-831~~ for each major test, evaluation or demonstration. Unless the Project Office specifies the report format, the following outline shall be used:

a. Title: Type and phase of testing for example: Human Factors Engineering Support to the A-7E TECHEVAL (DT-III).

b. Scope: Constraints due to time/budget/manpower.

c. Objective: Purpose and expected accomplishments.

d. Requirements and Criteria: Derived from the TEMP and detailed test plan.

e. Methodology: Description of how the parameters were selected and how data was collected.

f. Support Requirement: Description of facilities, instrumentation, and special services needed to conduct the tests.

g. Data Reduction and Analysis: Description of data processing and treatment.

h. Test Results: Description of findings, use of test data and reporting thereof.

i. Recommendations: May be required by Project Office to submit under separate cover.

REPORT, HUMAN ENGINEERING FINAL DI-H-2112

Blocks 1, 2, 3, 4, 5, 6, 8 & 9 - no change

7. APPLICATION,INTERRELATIONSHIP
7.1 This data item summarizes the contractor's human engineering efforts performed under MIL-H-46855. ~~para//3.7.2.3.~~

7.2 The report will be used by the procuring activity to evaluate the contractor's human engineering efforts and to serve as a baseline for application to subsequent system improvements and future procurements.

7.3 This data item is related to DI-H-2104, Human Engineering Program Plan.

10. PREPARATION INSTRUCTIONS
10.1 Unless otherwise indicated herein, the documents cited in this block, of the issue in effect on date of invitation for bids or request for proposals, form a part of this DID to the extent specified herein.

10.2 The Human Engineering Final Report shall be prepared ~~in compliance with MIL-H-46855, para 3.7.2.3~~ in contractor format which shall:

a. Describe the system, by major item, and outline the activities performed and results achieved in accordance with the contract and the Human Engineering Program Plan (DI-H-2104).

b. Summarize human engineering input to the following areas:
(1) Equipment detail design.
(2) Work environment, facilities design and safety.
(3) Contractor prepared system performance and design specifications, and acceptance test specifications.
(4) Reports of subcontractors human engineering activities
(5) Studies.
(6) Design reviews.
(7) Verification, test and evaluation.

c. Describe remaining human engineering problems, if any, and recommend remedial action.

d. Provide human engineering recommendations for system improvements and/or future procurements.

INSTRUCTIONAL DOCUMENTATION DRAFT

Subject: Human Factors Engineering Test and Evaluation

References: (a) NAVMATINST 3900.9
(b) OPNAVINST 3960.10
(c) NAVMATINST 3960.6

1. Purpose. This instruction establishes policies and requirements necessary to insure adequate development of human factors engineering (HFE) test and evaluation (T&E) of systems and equipment under the cognizance of the _____. This includes the clarification and implementation of HFE T&E technology throughout the procurement cycle of all naval systems.

2. Definitions. The term "human factors" refers to the activities required to integrate the human operator and maintainer into a system. It is further defined in reference (a) NAVMATINST 3900.9 Human Factors. HFE T&E is defined as: All testing dealing with equipment, task, environment, and personnel variables as they affect the human operator/maintainer's performance, safety, and comfort relative to meeting overall system goals. HFE T&E is further defined as the effort required to improve those design characteristics of a system which have an identifiable impact on the proper functioning of the operator/maintainer element within the system. It is necessary to verify that the operator/maintainer element of the system can meet specified performance requirements during the entire course of mission accomplishment. HFE T&E should encompass not only testing of a system in its final configuration but also testing of the original design concepts and initial design products.

3. Background. The Navy System Acquisition Cycle is made up of several stages, starting with the operational requirements stage and continuing through the operational test and evaluation stage. HFE is involved in all stages, ranging from the early conceptual requirements, through detail design, and the test and evaluation of the total system. Managing and coordinating

Navy HFE requires formal documentation of the decision points of who, when, and how the HFE effort should be implemented to achieve an efficient and effective role in the system acquisition process. Reference (a) is the most significant requirement for HFE. Reference (b), OPNAVINST 3960.10, Test and Evaluation, establishes policies of T&E in Navy acquisition programs and defines T&E responsibilities for various organizations. It establishes procedures for planning, conducting, and reporting T&E. It describes the relationship between developmental and operational T&E. Reference (c), NAVMATINST 3960.6, Planning and Implementation of Tests and Evaluations of New Weapon Systems, provides guidance for the planning and implementation of tests and evaluations required as a part of the system acquisition process. This instruction provides guidance for preparing the Test and Evaluation Master Plan (TEMP).

4. Objectives. The objective of the HFE T&E technology effort is to provide systematic evaluation and documentation of HFE requirements, assumptions, and data throughout the evolution of naval systems. In particular, the HFE T&E effort shall: a) assure the accomplishment of applicable HFE program requirements; b) demonstrate conformance of system, equipment and facility design to human engineering design criteria; c) confirm compliance with performance requirements where man is a performance determinant; d) secure quantitative measures of system performance which are a function of man-machine interaction; e) evaluate training; f) evaluate qualitative and quantitative personnel selection criteria; and g) determine whether undesirable design or procedural features have been introduced.

5. Scope. The requirements of this instruction are applicable to all systems and equipment development programs, projects and production efforts under the cognizance of the _____.

6. Policy. HFE T&E shall be performed to verify that design of equipment, software, facilities and environment meets HFE criteria and is compatible with the overall program requirements.

   (a) HFE testing shall be incorporated into the T&E program, including the TEMP, and shall be integrated into engineering design tests, demonstrations, R&D acceptance tests and

other major development tests. Compliance with HFE requirements shall be tested as early as possible. HFE findings from early testing shall be used in planning and conducting later tests.

(b) The HFE T&E program shall be developed and documented in approved test plans including the TEMP. Test documentation shall be available at the test site. HFE portions of all tests shall include, where applicable, the following:

(1) The actual conduct or simulation of the mission tasks.

(2) Tests in which the operator/maintainer participation is critical with respect to speed, accuracy, reliability or cost.

(3) A representative sample of non-critical scheduled and unscheduled maintenance tasks.

(4) Proposed technical publications or other job aids.

(5) Utilization of personnel who are representative of the range of the intended Navy user population in terms of skills, training, size and strength and who are wearing suitable Navy garments and equipment which are appropriate to the task.

(6) Collection of task performance data.

(7) Identification of discrepancies between required and obtained task performance.

(8) Criteria for the acceptable performance of the test.

(c) HFE T&E will include an HFE information system for documentation storage and retrieval of HFE T&E data for use by managers, planners, and designers of future systems.

The information system will serve as a focal point which would be addressed by test and evaluation, research and development, and training personnel needing information on some element in the evolution of weapon systems.

(d) The routine HFE T&E effort consists of a critique of the ability of a human to successfully operate or maintain a weapon system. Occassionally HFE T&E findings indicate problems which need resolution by efforts other than HFE T&E. Under this system, such problems are entered into the HFE information system indicated in the previous section. This data would then be reviewed by appropriate personnel who would collate, interpret, and assign priorities for the solutions to the problems. These personnel would also be responsible for either selecting the agency best qualified to resolve these problems, or, when appropriate, informing the appropriate training agency of the problem. The research and development community will thereby be tasked with real problems which will lead to 1) the establishment of new or improved criterion, 2) new testing techniques or equipment, and/or 3) advances in the state-of-the-art.

7. Action. The Project Support Officer representing the principal development agency is responsible for:

(a) Initiating the HFE T&E effort as early as possible and continuing the effort throughout the system acquisition process.

(b) Developing and maintaining an HFE T&E portion of the TEMP. The HFE effort shall be thoroughly integrated with the total program T&E effort.

(c) Ensuring all necessary HFE T&E liaison and coordination with other agencies for test planning and scheduling are accomplished.

(d) Appointing the organizational element and designated focal point assigned responsibility for HFE T&E.

(e) Ensuring that all necessary HFE T&E is accomplished prior to key decisions for continuing program development or for initiating production (e.g., DSARC milestones).